

RAIN STORM OF SEPTEMBER 9-10, 1952

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Central Texas was the scene of unusually heavy rains on September 9-10, 1952. Two-day totals of up to 21 inches were recorded. This brief summary will concern itself mainly with the heavier rain of September 10, although substantial amounts were recorded on the preceding day.

The week before the storm saw the season's first invasion of continental polar air into southern Texas. Modification of this air mass, which also covered part of northern Mexico, proceeded slowly during the next few days. The high pressure system accompanying the polar outbreak resulted in northeasterly winds over most of the Gulf of Mexico for an extended period. A reinforcement of the High by a fresh polar outbreak raised the pressure over the southeastern States on the 9th. This pressure rise moved westward into eastern Texas on the 10th in diminished form. Until September 8 the surface isobars, followed upwind from southern Texas, turned northward along the Atlantic seaboard. On the 8th, however, the pressure field altered somewhat, so that the isobars then arrived from the West Indies and disturbances of subtropical origin subsequently had access to southern Texas.

One such disturbance was the easterly wave which arrived over southern Texas on September 9-10. Figures 1, 2, and 3 are 24-hour sea level pressure change charts for 0630 and 1830 GMT September 9 and 0630 GMT Septem-

ber 10, showing the movement and change in intensity of both the rise and fall areas. The movement of the wave is shown by figures 4 and 5, portions of the 1500 GMT 700-mb. chart for September 9 and 10 respectively. Data for these were copied from teletype signals as received at the WBAN Analysis Center. On figure 4 a weak trough

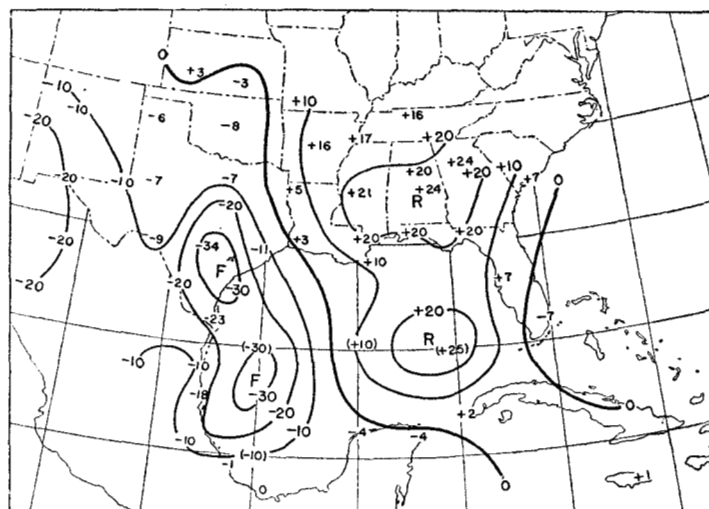
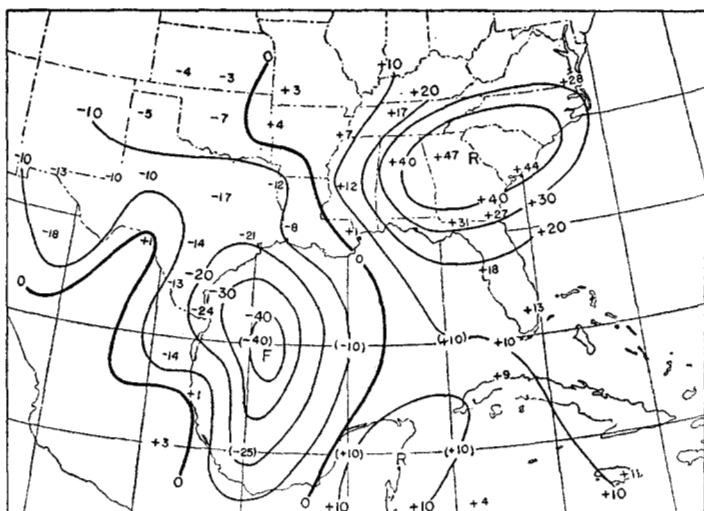


FIGURE 2.—Chart of sea level 24-hour pressure change, 1830 GMT, September 9, 1952. Isallobars are labeled in tenths of a millibar. "R" and "F" indicate centers of rise and fall.



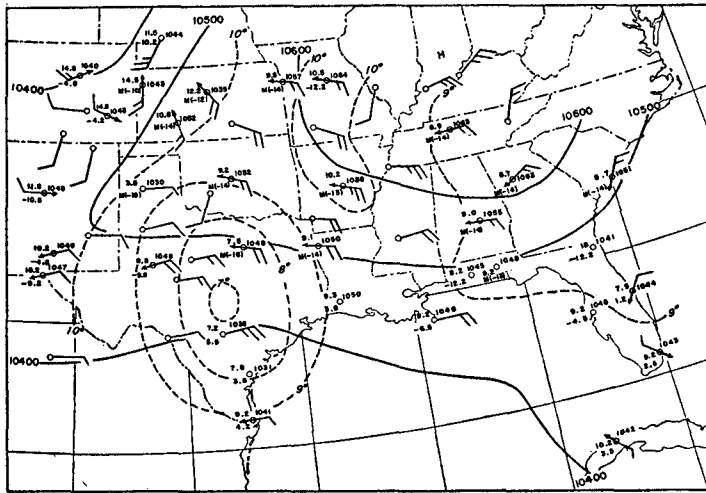


FIGURE 4.—700-mb. constant pressure chart for 1500 GMT, September 9, 1952. Contours are labeled in feet, isotherms in °C. Arrowed winds through station circle are from rawinsonde data, other winds from pilot balloon data.

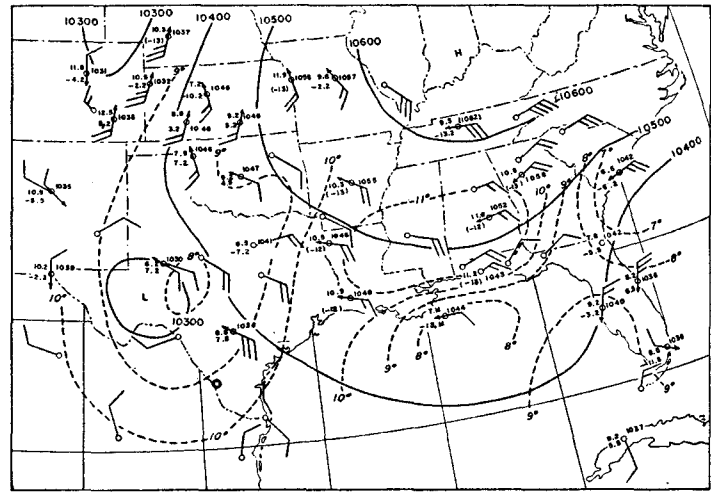


FIGURE 5.—700-mb. constant pressure chart for 1500 GMT, September 10, 1952. Contours are labeled in feet, isotherms in °C. Arrowed winds through station circle are from rawinsonde data, other winds from pilot balloon data.

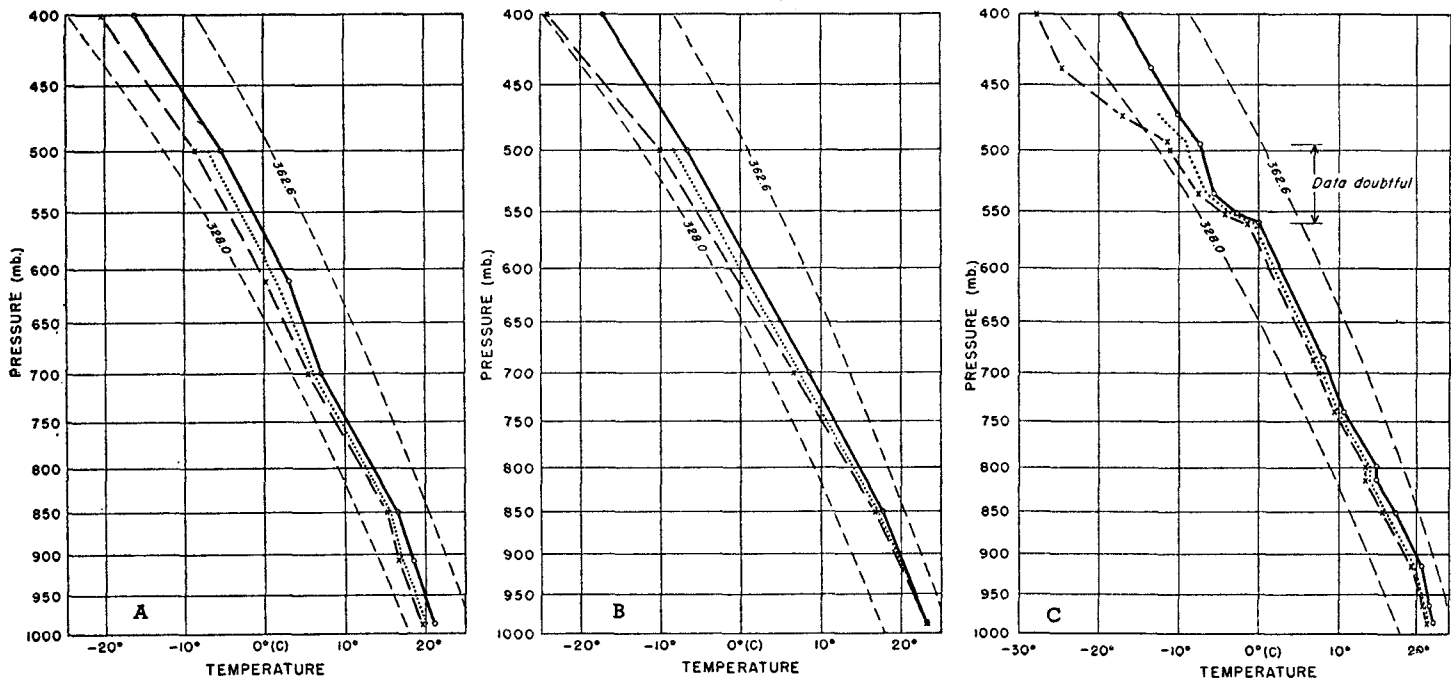


FIGURE 6.—Temperature soundings (solid line) dewpoint (heavy dashed line) and pseudo-wet bulb temperature (dotted line) curves at San Antonio, Tex. (A) 1500 GMT, September 9, 1952; (B) 0300 GMT, September 10, 1952; (C) 1500 GMT, September 10, 1952.

in the easterlies is discernible at about longitude 97° W. Twenty-four hours later (fig. 5) the trough, having developed a closed center, is seen to be centered at about longitude 102° W. The positions agree closely with the locations of the 24-hour katalobaric centers as illustrated in figures 1, 2, and 3.

The plotted San Antonio raobs for 1500 GMT September 9 and for 0300 and 1500 GMT of the 10th are shown in figure 6. San Antonio reported light rain falling at the surface in all three cases. The pseudo-wet bulb curve from 850 to 700 mb. on the sounding for 1500 GMT of

the 9th is steeper than the moist adiabatic curve, revealing convective instability through the layer. By the time of the next sounding at 0300 GMT of September 10 (just prior to the heavy rain) convective instability was general from the surface to 15,000 feet. A very small amount of lift would induce complete saturation of this air column. Presumably the slope up to the Edwards Plateau, which is located 25 to 50 miles northwest of San Antonio, did provide the necessary lift to produce saturation and consequent instability. The sounding of 1500 GMT, September 10 (fig. 6C) shows conditions at the time of heavy

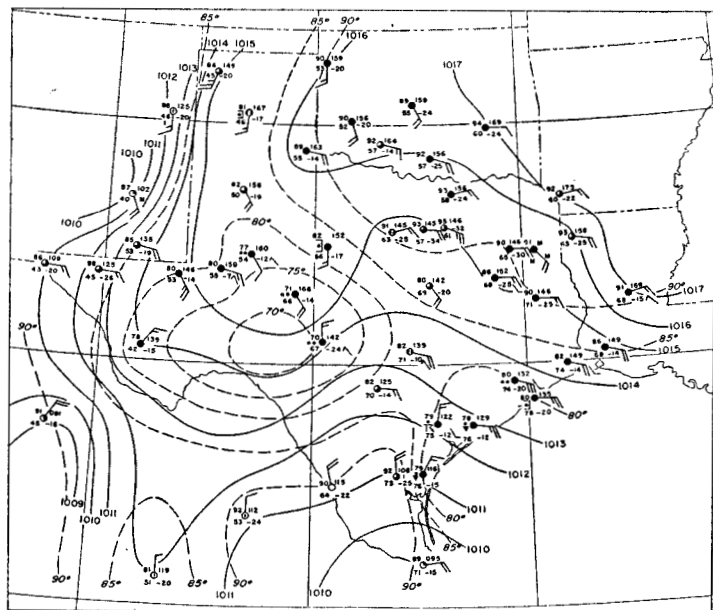


FIGURE 7.—Sea level chart for 2130 GMT, September 9, 1952. Temperatures are in °F.

rain. The curve is characterized by alternate layers of convective instability and stability and a lapse rate very close to moist adiabatic.

A study was made of temperature advection at the 850- and 700-mb. levels over the rain area, using a small temperature interval for analysis purposes. Slight warm geostrophic advection was found at both levels, in accordance with findings in other great rain storms. However, since the Gulf of Mexico, a large void insofar as upper air analysis is concerned, was but a short distance upwind during the heavy rain period, the analysis of temperature advection aloft is open to considerable doubt. With this in mind a careful analysis was made of the surface charts.

In the study of other large storms it has been found that a micro-analysis of the surface chart reflects to a large extent the details of temperature advection in the lower layers. Because of the much denser network of stations providing surface data, the advection can be pinpointed.

Figure 8 illustrates the geostrophic advection as shown on the surface map for 2130 GMT, September 10. Isobars are drawn for every millibar, and isotherms for each 5° F. (The advection is inversely proportional to the size of the areas formed by the intersection of the isobars and isotherms.) A generalized preliminary isohyetal pattern for the 24-hour period ending September 11 is also superimposed. The coincidence of concentrated warm geostrophic advection is notable over the heavy rain area. By contrast, the warm advection was considerably weaker on September 9 (fig. 7). The important difference affecting advection was the increase in pressure gradient; the San Antonio-Austin pressure difference increased from 1.4 mb. at 2130 GMT, September 9, to 3.4 mb. 24 hours

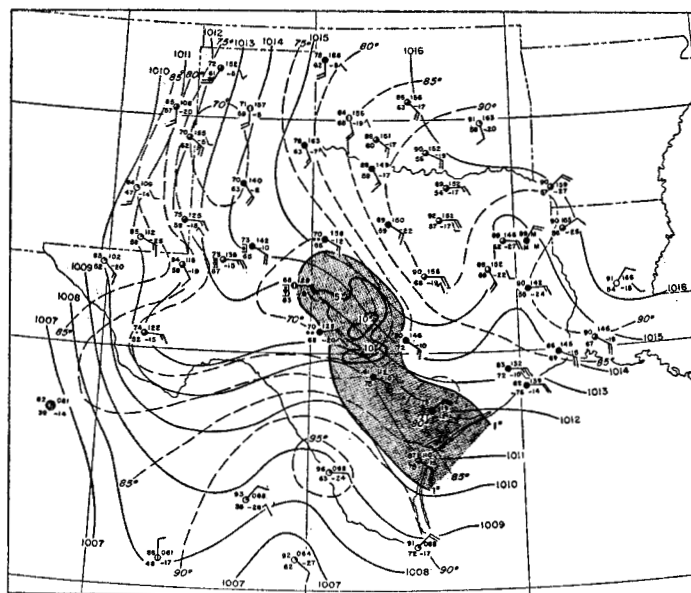


FIGURE 8.—Sea level chart for 2130 GMT, September 10, 1952. Temperatures are in °F. A generalization of the isohyetal pattern in the vicinity of San Antonio for the 24-hour period ending 1230 GMT, September 11, 1952 is shown by stippling.

later. The steepening of the pressure gradient was mainly due to the arrival of the easterly wave.

The temperature gradient to the northwest of San Antonio existed on both the 9th and 10th as can be seen in figures 7 and 8. Cooling due to rainfall was probably responsible rather than advection, since surface air trajectories indicate a tropical rather than polar source for the cool air over the Plateau. Since these temperatures did not rise, despite marked warm geostrophic advection on the 10th, the warm advection indicates a concentrated area of strong vertical motion. This, in combination with the heavy moisture charge of the convectively unstable inflow air mass, could account for the geographical and temporal placement of heavy rain.

CONCLUSION

The combination of events present in this storm is not uncommon in other great storms. The Thrall, Tex., storm of September 9–10, 1921, for example, was similar in that a large body of rain-cooled air was penetrated by a compact katalobaric area that had been, in that case, associated with a hurricane which crossed the Mexican coast north of Tampico. In the present storm, the pressure gradient over a small localized area in central Texas was increased by the pressure fall provided by an easterly wave and a pressure rise area that moved in from the east-northeast. The coincidence of the increased pressure gradient, parallel to a marked temperature gradient (induced by previous rain), must be viewed as the fortuitous combination of circumstances that, operating on an air mass that was convectively unstable, caused the heavy rain of the 10th.

